Monitoring Metal Emissions with a XRF-Based CEMS

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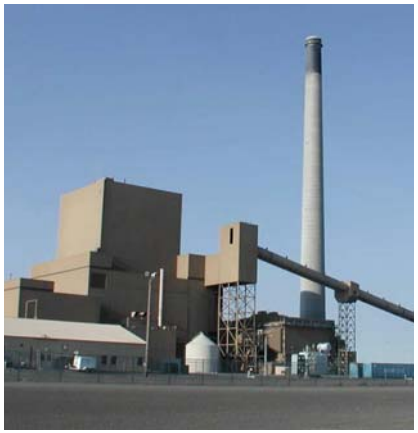
Problem Statement

Under the current Hazardous Waste Combustor Maximum Achievable Control Technology (HWC MACT) rule, heavy metal emissions from thermal hazardous waste incinerators are estimated using control efficiencies determined during performance testing and estimated metal feed rates during normal operation. Using this approach, the error in metal emissions can be on the order of 100%. This error would be greatly reduced by measuring metal emissions directly using a continuous emission monitor (CEM). Cooper Environmental Services LLC (CES) has developed a multi-metals CEM, the Xact™, which has been accepted by the USEPA for compliance purposes on a gas-fired thermal hazardous waste incinerator. The stack effluent from this facility, however, does not represent a particularly "challenging" environment in terms of moisture level, PM, SO_x and NO_x. The current SBIR project seeks to demonstrate the feasibility of using the Xact to measure metal emissions in the more challenging environment presented by a coal-fired thermal hazardous waste incinerator.



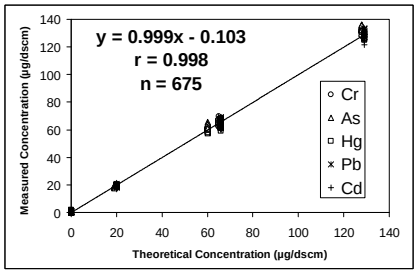
Technology Description

The Xact™ is an X-ray fluorescence (XRF) based multi-metal CEMS. Stack effluent is extracted from the facility and transported to the instrument. A small sub-sample is then drawn through reactive filter tape which traps particulate and vapor-phase metals. After sampling for a period of 15 minutes, the filter tape is advanced to the XRF analysis area where the mass of each metal is determined while the next sample is being collected. The concentration of each metal in the stack effluent is determined by dividing the XRF-determined mass by the volume of gas that has passed through the tape. The Xact can be used to measure concentrations of almost any element from aluminum (Al) to uranium (U), including arsenic (As), cadmium (Cd), chromium (Cr), lead (Pb), and mercury (Hg).

Expected Results

After installing the Xact at a coal-fired facility, the transport line will be dynamically spiked with known concentrations of metals using CES' Quantitative Aerosol Generator (QAG). The spiked concentration will be compared with the concentration reported by the Xact. We expect that the Xact's accuracy and precision will be unaffected by the stack effluent at a coal-fired facility. We expect that the average deviation between the Xact and the known spike concentration to be less than 20%. at the emission limit. Also, we will plot the Xact reported concentration versus the known spiked concentration over at least three concentration levels. The slope of a least squares fit of this data will be between 0.85 and 1.15 with a correlation coefficient greater than 0.90.

Xact Linearity Demonstration at a Natural Gas Fired Thermal Hazardous Waste Incinerator



Potential Environmental Benefits

- More Accurate Knowledge of Metal Emissions
  Current procedures for estimating metal emissions may have errors of 100% or more. Directly measuring metal emissions will result in far more accurate and reliable data.
- Better Understanding of Health Impact of Sources to Those in the Immediate Vicinity
- Better Feedback to Control Metal Emissions
  The Xact reports metal concentrations every 15 minutes. Constant feedback could allow plant operators to change operational parameters to reduce metal emissions.

Applicable Source Categories:

- Hazardous Waste Incinerators
- Coal-Fired Power Plants
- Medical Waste Incinerators
- Municipal Waste Incinerators
- Industrial Furnaces and Boilers
- Primary and Secondary Metal Smelters
- Sewage Sludge Incinerators

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